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ABSTRACT

Online learning is coming of age in both postsecondary education and industry. The courses now offered online range from kinesiology to mathematics to complete M.B.A. programs. The growing popularity of online education has created a need to reduce costs without diminishing the value of the edification. In response to this need, an instructional technology concept commonly referred to as the "learning object" was created. This paper explores the learning objects concept, their value to an online education, as well as an applied outlook into the use of learning objects in an online environment. The paper concludes with a discussion on how learning objects can be integrated into a specific example of an online course. (Contains 16 references.) (Author)

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Object Oriented Learning Objects in Online Education: A Framework and Example

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Abstract: Online learning is coming of age in both postsecondary education and industry. The range of courses now offered online ranges from kinesiology to mathematics to complete M.B.A. programs. The growing popularity of online education has created a need to reduce costs without diminishing the value of the edification. In response to this need, an instructional technology concept commonly referred to as the "learning object" was born. This paper explores the learning objects concept, their value to an online education, as well as an applied outlook into the use of learning objects in an online environment. The paper concludes with a discussion on how learning objects can be integrated into a specific example of an online course.

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Introduction

An online course often forces its creator to expend onerous amounts of time creating the course's lessons, assignments, and exams. This necessitates high time and cost investment (Rumble, 2001). By sharing similar learning materials the costs of an online course could be greatly reduced. Learning objects are a means of encouraging this type of collaboration.

Due to the promise of their innate simplicity and to their cost and time saving implications, learning objects have become one of the few concepts predicted to alter the landscape of learning in the near future. Groups from academics to multi-billion dollar organizations such as Microsoft are discussing and testing the potential impact of learning objects. Professors at Brigham Young University in Provo, Utah, for example, will be soon be able to develop, capture, and deliver learning objects through their own university wide system (South, Monson 2001). Microsoft's Learning Resource (LRM) interchange toolkit is a product geared towards developing and manipulating learning objects.

This paper discusses the rapidly growing topic of learning objects. First a plethora of 'learning object' definitions are reviewed as groundwork for a working definition of the learning object term. A brief discussion of the relationship between learning objects and other object-oriented frameworks is followed by a classification scheme for learning objects. The potential positive consequences of learning objects on an online education are then outlined. The practical applications of learning objects on an online environment are discussed with a particular emphasis on the construction of an online course and its components. Finally an example application of how to start to transform an online course to a learning-object based online course is offered.

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Learning Objects in an Object-Oriented Framework

Another means of understanding the learning object term is to view them as object-oriented elements.

In the last decade or so object-oriented techniques have dominated the information technology community. This community defines object-oriented objects as "a self-contained entity that consists of both data and procedures to manipulate the data" (Tech-glossary, 2002). The object's data, also referred to as attributes, is used to represent important information about the object. The object's procedures, on the other hand, represent things that the object can do. For instance, a dog object would consist of attributes, such as furry hair and four legs, and would also be composed of procedures, such as barking.

In order to allow learning objects to be easily accessible, each learning object must have at least a title and/or author associated with it. Hence a learning object's *attributes* could consist of things such as a title and author. Since learning objects are modular building blocks, they must have the ability to be combined and separated. The combining and separating actions performed by a typical learning object are some of its *procedures*. Since learning objects satisfy the prerequisites of possessing both *attributes* and *procedures*, they are object-oriented objects.

Background

Nearly a decade ago Wayne Hodgins, a learning and informant futurist, gave birth to the term "learning objects." Hodgins coined the term while watching his children play with Lego. The plug-and-play and reusability characteristics of the parts ignited the idea of objects that, in a similar manner to Lego parts, could be used to build learning modules (Jacobsen, 2001).

Learning objects have since become an extremely popular topic. As a result there have been numerous groups attempt to provide a definition for what they believe learning objects to be. There currently exist hundreds of definitions for the learning objects term in the World Wide Web. With such a vast number of differing explanations, it can be a struggle to merely define learning objects let alone understand how to use them. It is easiest to view these definitions as a spectrum with those who view a learning object as an abstract *concept* at one end, and those who view learning objects as a *product* in the other.

At one end of the spectrum the Learning Technology Standards Committee (LTSC) characterize learning objects as "any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning" (LOM, 2000). This definition views learning objects as an extremely broad and abstract concept. By allowing any entity "referenced during technology supported learning" to be a learning object, LTSC allows most persons, places or things to fall under the learning object classification.

At the opposite end of the spectrum commercial vendors, such as Cisco, often provide more focused and product based learning object definitions. Vendors' definitions tend to encapsulate their, often proprietary but sometimes open standard, products. Cisco's Reusable Learning Object (RLO) is defined as "a sum of one or more Cisco Reusable Information Objects (RIO)" (Barron, 2000). A Cisco RIO is defined to be "any concept, fact, process, principle, or procedure" (Barron, 2000). The fact that each RLO is made up of one or more Cisco RIO's, and that learning

object based solutions are implemented by Cisco's own "Converged Voice, Video, and Data Products" (Cisco Systems, 2001), demonstrates that Cisco's learning object's definition encapsulates their own products.

To avoid the trap of providing a very narrow definition that depends on a particular company's products, or of having a definition so abstract that even a single piece of paper could be considered a learning object, A learning object will be defined here to be:

> "A digital, reusable, modular, and easily accessible building block comprised of a *content* and an *assessment* component"

The digital characteristic constrains a learning object to something that can be distributed through some sort of electronic medium. The reusability characteristic ensures that a learning object may be produced once and reused many times thereafter. Since a learning object can be an online lesson, or merely a portion of it, the learning object must also be modular. The modularity characteristic implies that, like most building blocks of any sort, multiple learning objects can be combined into larger learning objects. Finally, learning objects must be easily accessible, so that it is possible to locate a particular one in a reasonable amount of time. The content portion of the learning object is meant to encapsulate the knowledge this object is supposed to teach. Whereas the assessment portion encapsulates numerous questions that can be used to assess that particular learning object's content.

Classifying Learning Objects

Attributes of learning objects such as title and author allow a learning object to be easily found. The type of information that allows us to classify and consequently find learning objects is called "Metadata."

Roberts and McGreal define Metadata as "data about data" (2001). In a library the information in the book catalog is a collection of metadata about books. A book's author, book name and publisher are all pertinent data to that book.

In order to satisfy the easily accessible characteristic of learning objects, it makes sense to provide metadata similar to a book's metadata. Currently the Learning Objects Metadata Working Group is creating standards that specify the metadata for learning objects (such as Title, Author, Version, Format, etc.). These standards will be crucial to the use of learning objects since they will allow learning objects to be effortlessly classified. Once all learning objects abide the metadata standards, individuals creating learning content will be able to find the learning objects they are searching for without difficulty.

Learning objects in online instruction

A working definition of the learning object term precedes an analysis of the importance of learning objects to online education. Typically an educational online content creator may spend countless hours building a single educational component. Using learning objects can help reduce the time and monetary costs associated with the repetitive construction of online and, potentially, face to face instruction. Learning Objects are able to eliminate costs by promoting content reuse and by allowing multiple and simultaneous access of the content. Additional positive side effects of learning objects include ease of use, familiarity in instructional content creation, and the potential for personalized instruction.

1. Content Reuse. The fundamental idea behind learning objects is that instructional designers can build small instructional components (or learning objects) that can be reused a number of times in different learning contexts. For example all first year calculus courses, regardless of faculty, have at least one lesson on trigonometric differentiation. Rather than have to create separate lessons on this topic for each calculus course, learning objects reusability characteristic allows the creation of a distinct trigonometric differentiation lesson from the same learning object. They may all use different examples to elaborate on the topic but, since the essence of the topic is the same, the same learning object can be used to provide a more rapid and cheaper instructional content construction than with typical online content construction.

2. Multiple and simultaneous access. Since learning objects are digital entities, they are deliverable over the Internet. As a result any number of people can access and use learning objects simultaneously (Willey, 2001). Time is saved since multiple and simultaneous access implies that when creating online lessons multiple content creators can access the same learning object concurrently.

3. Familiarity in instructional content creation. Reigeluth and Nelson suggest that when teachers first gain access to instructional materials, they typically break the materials down into their constituent parts, and then reassemble these parts in ways that support their instructional goals (1997). Since learning object's can be sequentially combined, the task of creating online content is a natural one.

4. Personalized Instruction: Individuals have differing learning needs, interests and learning styles; therefore they can benefit from instruction that is personalized to their needs. Learning objects can accommodate a learner's preference and style because of their inherent characteristics. In particular, learning objects' accessibility, ease of use and reusability characteristics promotes the use of differing instructional strategies to fit that of the learner's

Issues in Applying Learning Objects

How Are Learning Objects Intended To Be Used?

A surplus of techniques for creating and interacting with learning objects exists. The basic handling of learning objects is intended to be:

1. Allow access to learning objects in an on-demand fashion
2. Allow the creation and submission of learning objects

Building this type of interaction necessitates a repository where learning objects can be uploaded and downloaded. Due to the modular characteristic of learning objects discussed previously, our repository will contain learning objects of various granularity types. At the lowest end of the granularity spectrum, an *atomic* learning object is defined as a learning object that solely focuses on one topic. Higher-order learning objects differ from atomic ones in that they focus on more than one topic, and hence are an amalgamation of distinct learning objects. In the sections that follow various techniques for creating higher-order learning objects shall be explored.

An Application: Systems Analysis and Design

A senior undergraduate course in Business Administration has been offered both place-based and online for several years. Each has an identical set of learning objectives, but the delivery format differs in the Spring versus Summer and Fall offerings. Using the above definition, learning objectives could be categorized, learning objects derived, and the course offered more consistently in both formats and updated in a more modular fashion. First, an inventory of topics is outlined. A weekly lecture, for example, is typically made up of one to three topics, such as 'Introduction to Systems Analysis,' 'The Systems Development Life Cycle,' and 'Problem Finding and Problem Solving Methodologies' in a first week of such a course. Each topic is then stored separately with a series of attributes. In the systems analysis course, the attributes are:

- Text title(s) and chapter(s) (text)
- Online lecture notes (html)
- Face to face presentation file (MS Powerpoint)
- Weekly exercise outline (text)
- Discussion question(s) (text)
- Examination question(s) (text)
- Relevant WWW links (text listing)

A course outline, then, links a series of such objects into a repository. Each topic serves as a kernel to comprise an overall course, and seeds a course web site (another higher level object) which presents the elements relevant to the audience. Over time, multiple teachers could add elements, examples, and new links to each object, and objects could be used in different combinations for different audiences and related topical overviews.

Tools to Support Learning Objects

Standards for support, such as XML objects, have been touted as 'Learning Objects.' The concept is more a modularization of course elements than identification of a software or standard at this point, but certain tools will prove beneficial as this concept matures. No single standard has yet surfaced that will converge the concept of Learning Objects, but the formalization of the topic promises to standardize elements used to build support for a learning outcome.

A final caveat remains with the notion of 'art' versus 'science.' Support materials for courseware can be standardized and stored, but excellent support cannot guarantee excellent learning experiences. New examples constantly emerge, and different personalities teach with different approaches. A support repository containing categorized objects and methods, however, will offer us a language to communicate among different teachers of the same material, and build on past successes rather than reinventing the discussion each time. The concern of a single

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